

FineRehab: A Multi-modality and Multi-task Dataset for Rehabilitation Analysis —Supplementary Material

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1. FineRehab[§] Dataset

1.1. Information about the subjects

Fifty volunteers, comprising 22 females and 28 males, participated in this study. Among these participants, 30 are musculoskeletal disorders patients, exhibiting varying degrees of stroke-induced motor dysfunctions due to musculoskeletal disorders. The remaining 20 subjects are healthy individuals who reported no known movement disorders or other health problems that could affect their mobility. Basic demographic and clinical information for both groups are summarized in Table 1. The age range for the healthy adult group was specifically chosen to represent the general healthy adult population and accurately reflect standard exercise criteria. In addition, the Anthropometric details, along with age, sex, affect side, specific motor conditions and identification number (ID) of each subject group are presented in our dataset.

Table 1 Basic information of two subject groups.

Group	Age	Height (cm)	Weight (kg)	BMI
Patient	28-92	168.67 ±	68.13 ±	23.94 ±
		7.25	9.09	2.96
Healthy	19-24	167.6 ±	60.95 ±	21.56 ±
		7.51	10.76	2.47

The criteria for inclusion in the movement acquisition experiment are as follows:

1. Adherence to the diagnostic guidelines of the 2018 Chinese guidelines for acute ischemic stroke diagnosis [1] or Chinese Stroke Association guidelines for clinical management of cerebrovascular disorders [2].

2. Diagnosis of a single lesion via CT or MRI, marking

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§FineRehab can be found at: <https://bsu3dvlab.github.io/FineRehab>

the first occurrence of the condition.

3. Condition duration ranging from 1 to 6 months, with unilateral deviation, the affected side's Brounstrom stage ≥ 3 in the lower limbs, FAC \geq grade 2, enabling short-distance walking capabilities without significant sensory impairment.

4. Positive cooperation and comprehension abilities regarding the test procedures.

5. Absence of severe organic lesions or psychiatric-related diseases.

Exclusion criteria encompassed unstable conditions (e.g., postural hypotension, hypoglycemia), significant cognitive impairments or depression, severe cardiopulmonary dysfunctions, or other infectious diseases, and pronounced dysfunction or sequelae in the joints of hip, knee and ankle. Patient enrollment was conducted following diagnoses confirmed by specialists from the department of neurological rehabilitation at the China Rehabilitation Research Centre.

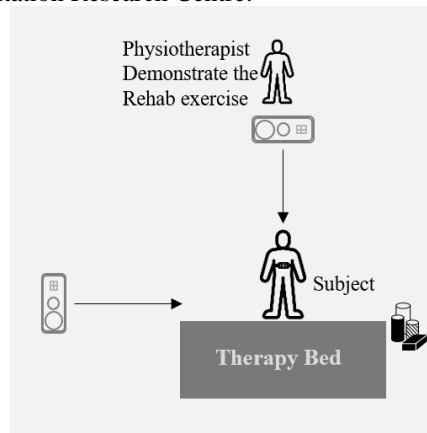


Figure 1 Setup of data acquisition experiment.

1.2. Experiment setup

The setup of data acquisition experiment is depicted in Figure 1. The IMUs were strapped to the subject's *head, shoulder blades, upper back, lower back, arms, forearms,*

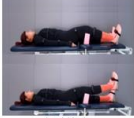








hands, thighs, calves and feet. Video are recorded by two Kinect Azure cameras from front and side view simultaneously. A physiotherapist stood behind front-view Kinect camera facing patient to demonstrate the exercise.

1.3. Exercise description

The rehabilitation exercises, chosen for potential to assist patients with musculoskeletal disorders in regaining

normal joint mobility, enhancing muscle strength, and improving motor coordination, were vetted by rehabilitation experts for clinical applicability and relevance. The exercise in FineRehab encompass three positions (upright, seated, and supine) to meet the needs at different stages of recovery. Detailed descriptions of the selected exercises are shown in Table 2.

Table 2 Description of 16 rehabilitation movements in FineRehab dataset.

ID	Movement Name	Description	Schema	Position
01	Terminal Knee Extension	Lie down on the bed. Place a foam roller underneath the knees, resting both heels on the bed. Flex one calf with pointing toes directly up towards the ceiling. Slowly reverse and repeat.		Supine
02	Straight Leg Raise	Lie down on the bed. Lift one leg off the bed, keeping the knee locked straight. In a controlled manner, reverse and repeat.		Supine
03	Heel Slides	Lie on your back with both legs straight. Slide one heel towards buttocks, then slowly reverse until the leg is straight again and repeat.		Supine
04	Alternating hip flexion	Lie on your back with both knees bending 90°. Lift one knee up towards your chest alternately. In a controlled manner, reverse and repeat.		Supine
05	Ankle Pumps	Lie down on the bed. Place a foam roller underneath heel. Complete one side dorsal flexion and plantar flexion (toes toward and away body).		Supine
06	Hip Bridge	Lie on your back Flatten the curve of your back against the bed with bending knees and flat feet. Gently tilt the pelvis and lift up your hips. Slowly bring your hips down and relax, then repeat.		Supine
07	Spine Rotation	Lie down on the bed. Using your upper body, turn to one side and then the other while keeping your head supported on a pillow, but allow your head and arms to follow the movement.		Supine
08	Knee Extension	Sit upright. Clasp hands together, reaching above head. Slowly straighten one side knee, pointing the toes towards the ceiling. Control the movement as slowly lowering the leg back down and repeat.		Sitting
09	Hip Adduction	Begin sitting upright with bent knees and hands reaching above head. Place a yoga block between knees. squeeze the block with thighs towards each other and calf away each other.		Sitting

10	Sit to Stand	Begin sitting upright with flat feet on the floor. Reach hands above head, lean upper body forward, then stand up. Slowly sit back down and repeat.		Sitting
11	Heel Raises	Begin standing with a solid object support. Rise up on to both toes and keep balance. Control the movement as body lower back down and repeat.		Standing
12	Marching	Begin standing with a solid object support. March on the spot by alternating lifting knee up as high as the level of hips. Aim to complete the movement slowly whilst maintaining balance on standing leg.		Standing
13	Half Squat	Stand behind bed and place hands onto it with light support. Bend both knees into a half-squatting position, allowing hands to slide forwards. Hips should travel backwards as counterbalance by leaning chest forwards. Slowly reverse and repeat.		Standing
14	Side tap	Stand behind bed and place hands onto it with light support. Stand on one leg and move the other side. Use heel to tap forward and toes to tap backward.		Standing
15	Hip abduction	Stand on one side of the bed, hold the bed with closest hand, and raise the other hand over head. When ready stand on the leg closest to the support object and move the other leg away from the midline of the body.		Standing
16	Shifting weight, forward/backward	Stand up straight close to the bed for support. one-foot Step forwards as though taking a small step. Spread your weight evenly across both feet. Gently sway forwards and backwards onto your front and back feet while keeping your balance.		Standing

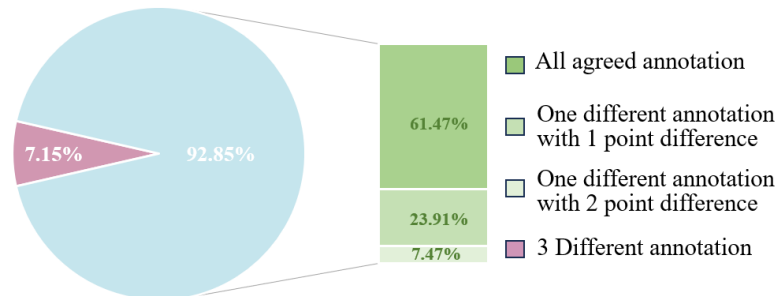


Figure 2 Distribution of annotation in FineRehab.

1.4. Annotation results

The final annotation of single snippets was determined by a majority vote. The statistics result of annotation is depicted on Figure 2. There are 92.85% annotation saved as majority vote. The other 7.15% are reannotated by clinical expert and determine the final results.

2. Rehabilitation exercise analysis

We benchmark 2 skeleton-based models, ST-GCN [3] and UNIK [4], on FineRehab. In the benchmark, we focus on action recognition with multi-modality, cross-subject comparison, and the performance of mainstream methods in action quality assessment. The parameters of all models are shown in the Table 3.

Table 3 The Top-1 accuracies cross-models and skeletons with different parameters.

Models	Lr	Data	Estimated	Aug	Best Epoch	Accuracy	Precision	Recall	F1 Score
ST--GCN	0.005	H ¹	◆	△	174	84.35%	85.72%	84.22%	84.06%
ST-GCN	0.005	H ¹	◆	◎	119	90.34%	90.42%	90.83%	90.50%
ST-GCN	0.0002	H ¹	◆	△	144	84.60%	85.33%	84.90%	84.31%
ST-GCN	0.0002	H ¹	◆	◎	99	91.80%	92.27%	92.58%	91.80%
ST-GCN	0.005	P ²	◆	△	124	77.61%	78.48%	78.16%	77.34%
ST-GCN	0.005	P ²	◆	◎	94	75.51%	77.90%	75.94%	75.67%
ST-GCN	0.0002	P ²	◆	△	184	78.12%	79.62%	79.24%	78.24%
ST-GCN	0.0002	P ²	◆	◎	169	78.55%	77.74%	78.90%	77.81%
ST-GCN	0.005	H&P ³	◆	△	139	87.94%	88.16%	88.97%	88.11%
ST-GCN	0.005	H&P ³	◆	◎	94	87.44%	86.46%	88.16%	86.95%
ST-GCN	0.0002	H&P ³	◆	△	119	84.62%	84.27%	86.09%	84.72%
ST-GCN	0.0002	H&P ³	◆	◎	78	84.62%	85.15%	86.05%	85.40%
ST-GCN	0.005	H ¹	★	△	74	77.07%	81.93%	76.84%	78.16%
ST-GCN	0.005	P ²	★	△	59	52.32%	64.78%	51.75%	52.86%
ST-GCN	0.005	H&P ³	★	△	79	80.02%	83.53%	80.07%	80.92%
UNIK	0.05	H ¹	◆	△	37	84.58%	84.23%	84.38%	84.40%
UNIK	0.05	P ²	◆	△	68	59.23%	59.43%	59.92%	59.23%
UNIK	0.05	H&P ³	◆	△	34	80.33%	84.16%	79.18%	80.33%
UNIK	0.05	H ¹	★	△	35	92.63%	93.43%	92.09%	92.35%
UNIK	0.05	P ²	★	△	63	76.07%	77.98%	76.69%	76.69%
UNIK	0.05	H&P ³	★	△	54	86.49%	87.27%	86.41%	86.50%

¹ H represents healthy participants.

² P represents patients.

³ H&P refers to all participants.

⁴ “◆” indicates that the skeleton data is estimated using MediaPipe [5].

⁵ “★” indicates that the skeleton data was directly collected via IMUs.

⁶ “◎” indicates that the skeleton data was augmented.

⁷ “△” indicates that the skeleton data was not augmented.

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